Maternal Tobacco Use and Shorter Newborn Nursery Stays

Ian M. Paul, MD, MSc, Erik B. Lehman, MS, Rachel Widome, PhD, MHS

Objective: Nationally, 10%–15% of women report smoking during the last 3 months of pregnancy. Because the Joint Commission on Accreditation of Healthcare Organizations (now the Joint Commission) requires all U.S. hospitals to be smoke-free, and because tobacco is addictive, the maternal desire to smoke after childbirth could lead to requests for early hospital discharge for mothers and newborns. The authors hypothesized that maternal tobacco use would be associated with shorter newborn nursery hospital stays.

Methods: Birth records from 405,622 singleton, "well" newborns, ≥35 weeks gestation born from 1998 to 2002 in Pennsylvania were merged with perinatal hospital record data and analyzed from 2006 to 2008. Perinatal data from 67,145 mothers self-reporting as having smoked cigarettes on the Certificate of Live Birth and data on their infants were compared 1:2 with data from mothers reporting to be nonsmokers and their infants via chi-square tests with odds ratios, 2-sample *t*-tests, and multiple linear regression.

Results: In Pennsylvania, 16.6% of mothers smoked cigarettes during pregnancy. Tobacco-using mothers were more likely to be insured by Medicaid, unmarried, adolescent, not college educated, and have late onset of prenatal care. Their newborns were more likely to be low birth weight and be born at 35–36 weeks gestation. Nonetheless, these newborns had a significantly shorter mean length of stay (48.9 hours vs 52.4 hours; $p<0.001$), even after adjusting for confounders. A significant inverse relationship existed between number of cigarettes smoked per day by mothers and nursery length of stay for newborns.

Conclusions: Hospital smoking bans send a strong public health message regarding the risks of tobacco and protect patients and staff from secondhand smoke exposure. However, the association between maternal tobacco use and shorter newborn hospital stays may demonstrate an unintended consequence for the vulnerable population of newborns whose mothers smoke. This association should be considered during prenatal counseling, where smoking cessation can be emphasized, and at the time of mother and infant discharge. These findings are particularly important given the health and socioeconomic disparities between smoking mother–infant pairs and their nonsmoking counterparts.

(Am J Prev Med 2009;37(2S):S172–S178)

Introduction

On December 31, 1993, the Joint Commission on Accreditation of Healthcare Organizations (now the Joint Commission) mandated that all accredited U.S. hospitals be "smoke-free."[1] This mandate has been supported and supplemented by many organizations including the American Academy of Pediatrics, which has advocated that physician offices, waiting rooms, and hospitals be smoke-free and further that sales of all tobacco products be banned in pediatric hospitals and facilities where children receive care.[2] More recently, many hospitals have developed policies ensuring that the entire campus, including outdoor areas, be entirely smoke-free.

Childbirth is the most common reason for hospitalization in the U.S., with approximately 4 million women giving birth each year.[3] Among these women, between 10% and 15% smoke tobacco,[4,5] and therefore, women who are current smokers and hospitalized for childbirth represent a substantial proportion of inpatients affected by hospital smoking bans. These women are likely to struggle with nicotine withdrawal while being confined in the smoke-free hospital environment.

Differing from other causes of hospitalization, the length of stay for the maternity hospitalization following childbirth is often negotiable, and a woman may

From the Departments of Pediatrics and Public Health Sciences, Penn State College of Medicine (Paul, Lehman), Hershey, Pennsylvania; and the Center for Chronic Disease Outcomes Research, Veterans Affairs Medical Center, and Department of Medicine, University of Minnesota (Widome), Minneapolis, Minnesota

Address correspondence and reprint requests to: Ian M. Paul, MD, MSc, Penn State College of Medicine, Department of Pediatrics, HS83, 500 University Drive, Hershey PA 17033. E-mail: ipaul@psu.edu.

0749-3797/09/$–see front matter
doi:10.1016/j.amepre.2009.05.004

elect to leave the hospital prior to the recommended 48-hour stay following discussion with her physician and her newborn's physician.[6,7] Because tobacco is addictive and because new mothers can ask for and may receive early discharge after childbirth, the authors hypothesized that self-reported maternal tobacco use during pregnancy would be associated with shorter newborn nursery stays. Further, it was postulated that the number of cigarettes smoked per day by mothers would be inversely associated with newborn nursery length of stay.

Methods

Subjects

A total of 521,656 birth records from singleton newborns ≥35 weeks gestation born in Pennsylvania between 1998 and 2002 were obtained from the Pennsylvania Department of Health (PDOH) birth registry for a retrospective analysis, conducted between 2006 and 2008. Of these birth records, 418,991 (80.3%) were successfully matched and then merged with the clinical discharge records for each newborn collected by the Pennsylvania Health Care Cost Containment Council (PHC4) through a matching procedure using date of birth, gender, subject-reported race and ethnicity, ZIP code, death status, hospital, gestation, and birth weight as variables in the absence of a Social Security number. To exclude those newborns not typically cared for in a "well-baby" newborn nursery, the only records selected for analysis were those in diagnosis-related groups (DRG) 391 (normal newborn) and 388 (preterm newborn without major problems) at discharge. Newborns with hospital charges >$8,000 (>98th percentile) and those with MediQual severity of illness ratings that were not "None" were excluded, because they were unlikely to represent the typical newborn nursery population. MediQual is a quality and performance analytical system required for all Pennsylvania hospitals, which is used to report risk-adjusted outcomes.[8]

Additionally, newborns with major problems that could result in a complicated, prolonged, or atypical newborn nursery stay such as respiratory distress syndrome, meconium aspiration syndrome, seizures, central nervous system anomalies, heart malformations, Down syndrome, and other chromosomal anomalies were excluded, as has been done in previous studies.[9–15] Of the remaining records, only those with maternal self-reported tobacco use or non-use were selected for further analysis, resulting in a cohort of 405,622 mother–newborn pairs (96.8% of those with merged PDOH/PHC4 records). Tobacco use during pregnancy was self-reported by 67,145 (16.6%) of mothers, and for the subsequent analyses this subgroup was matched 1:2 with those self-reporting not to have used tobacco. Matching was performed on year and quarter, to rid subsequent analyses of any unwanted confounding that could have been related to changes in care standards or public policy. This 1:2 matching allowed for an increase in the power of the analysis over matching 1:1. The Human Subjects Protection Office of the Penn State University College of Medicine approved this study.

Data Sources

The merged datasets from PDOH and PHC4 contained an extensive set of variables related to maternal health status and hospitalization, newborn health status and hospitalization, and maternal SES and other characteristics. Data from the prenatal period included timing and number of prenatal care visits, pregnancy weight gain, tobacco and alcohol use, and pregnancy complications including conditions such as hypertension, pregnancy-induced hypertension, and diabetes. Maternity and newborn hospital data included information on delivery type and complications, length of stay (LOS) in hours since delivery, infant birth weight, gender, gestational age, Apgar scores, and neonatal complications. Socioeconomic data and maternal characteristics included maternal race, ethnicity, age, parity, education, marital status, and insurance type. Information on newborn feeding type was not available.

Statistical Analyses

Perinatal data from mothers self-classified as using tobacco on the Pennsylvania Certificate of Live Birth and data on their infants were compared with data from mothers who reported that they did not use tobacco and data on their infants. To determine what variables were associated with maternal tobacco use, a bivariate analysis was conducted on the previously mentioned list of maternal and infant characteristics of interest. Because the LOS data were normally distributed, means are reported. Categoric variables were summarized with frequencies and percentages. Odds ratios and chi-square tests were used to quantify and test associations between mother's tobacco use and these categoric outcome variables. Two-sample *t*-tests with means and 95% confidence intervals were used to test for significant differences between tobacco-using and non-using mothers on outcomes measured by continuous variables.

A multiple linear regression analysis was then performed where mother's tobacco use was the primary independent variable of interest and hospital LOS was the outcome. Covariates to be included in this analysis were determined on the basis of the results of our bivariable analysis and an analysis of associations of the same set of maternal and infant characteristics with LOS. Potentially confounding variables that were clinically or statistically significant (from the bivariable analysis) were included in the full model in order to isolate the independent association of mother's tobacco use on hospital LOS. To create the final model, goodness of fit statistics were used to assess the fit of the model in the presence and absence of each potential covariate. All analyses were conducted using SAS statistical package version 9.1.3.

Results

Maternal Characteristics

Among the eligible subjects, 67,145 (16.6%) of newborns in Pennsylvania between 1998 and 2002 were born to mothers that used tobacco. Table 1 presents comparisons of perinatal characteristics of tobacco-using and non–tobacco-using mothers in the study. Frequency distributions or percentages are shown for tobacco-using women in the first column and for

Table 1. Perinatal comparison of tobacco-using mothers and their infants with non-using mothers and their infants

	Tobacco-using* N=67,145	(%)	Non–tobacco-using* N=134,290	(%)	Crude ORs (95% CL)	*p*-value
MATERNAL CHARACTERISTICS						
Age (years)						<0.001
<20	10,025	14.9	10,618	7.9	2.16 (2.09, 2.23)	
20–24	22,268	33.2	24,576	18.3	2.07 (2.02, 2.13)	
25–29	16,642	24.8	38,091	28.4	1.00 (ref)	
30–34	11,542	17.2	39,748	29.6	0.67 (0.65, 0.68)	
35–39	5,593	8.3	17,891	13.3	0.72 (0.69, 0.74)	
40	1,065	1.6	3,351	2.5	0.73(0.68, 0.78)	
Race						<0.001
White	59,348	89.0	113,604	85.2	1.00 (ref)	
Black	6,865	10.3	14,817	11.1	0.89 (0.86, 0.91)	
Asian or Pacific Islander	214	0.3	4,239	3.2	0.10 (0.08, 0.11)	
Other	237	0.4	616	0.5	0.74 (0.63, 0.86)	
Hispanic ethnicity	2,022	3.0	6,095	4.5	0.65 (0.62, 0.69)	<0.001
Married to newborn's father	28,281	42.1	101,539	75.6	0.24 (0.23, 0.24)	<0.001
Primiparous	24,010	35.9	55,167	41.2	0.80 (0.78, 0.81)	<0.001
Education						<0.001
≤High school graduate	50,220	76.7	53,533	40.7	1.00 (ref)	
Some college	11,625	17.8	30,740	23.4	0.40 (0.39, 0.41)	
≥4 years college	3,612	5.5	47,133	35.9	0.08 (0.08, 0.09)	
Insurance type						<0.001
Private	29,881	45.8	100,073	77.0	1.00 (ref)	
Medicaid	33,680	51.6	26,297	20.2	4.29 (4.20, 4.38)	
Uninsured	1,350	2.1	2,795	2.2	1.62 (1.51, 1.73)	
Other	378	0.6	860	0.7	1.47 (1.30, 1.66)	
PREGNANCY HISTORY						
Trimester began prenatal care						<0.001
1st	52,220	80.8	114,757	88.8	1.00 (ref)	
2nd	9,617	14.9	11,692	9.1	1.81 (1.76, 1.86)	
3rd	2,065	3.2	2,267	1.8	2.00 (1.88, 2.13)	
No prenatal care	701	1.1	473	0.4	3.25 (2.89, 3.66)	
Alcohol use during pregnancy	2,612	3.9	1,044	0.8	5.18 (4.82, 5.57)	<0.001
Pregnancy weight gain (pounds)						<0.001
0–19	13,265	21.0	18,178	14.8	1.63 (1.59, 1.67)	
20–39	33,750	53.5	75,228	61.3	1.00 (ref)	
≥40	16,042	25.4	29,339	23.9	1.22 (1.19, 1.25)	
Delivery type						<0.001
Vaginal	55,237	82.4	108,627	81.1	1.00 (ref)	
Cesarean section	11,805	17.6	25,302	18.9	0.92 (0.90, 0.94)	
INFANT CHARACTERISTICS						
Gender						0.05
Female	33,295	49.6	67,220	50.1	0.98 (0.96, 1.00)	
Male	33,850	50.4	67,070	49.9	1.00 (ref)	
Gestational age (weeks)						<0.001
35–36	3,466	5.2	5,124	3.8	1.40 (1.34, 1.47)	
37–38	16,183	24.3	30,566	22.9	1.10 (1.07, 1.12)	
39–40	38,435	57.6	79,728	59.7	1.00 (ref)	
≥41	8,641	13.0	18,210	13.6	0.98 (0.96, 1.01)	
Birth weight (grams)						<0.001
<2500	3,292	4.9	2,721	2.0	2.20 (2.08, 2.32)	
2500–2999	16,638	24.8	18,420	13.7	1.64 (1.60, 1.68)	
3000–3499	28,696	42.7	52,086	38.8	1.00 (ref)	
3500–3999	15,174	22.6	45,323	33.8	0.61 (0.59, 0.62)	
4000–4499	2,947	4.4	13,444	10.0	0.40 (0.38, 0.42)	
≥4500	394	0.6	2,295	1.7	0.31 (0.28, 0.35)	
Nursery length of stay (hours)						<0.001
<24	558	0.8	1,012	0.8	1.26 (1.14, 1.40)	
24 to <48	34,665	52.0	57,708	43.4	1.38 (1.35, 1.40)	
48 to <72	24,795	37.2	56,773	42.7	1.00 (ref)	
72 to <96	5,358	8.0	13,266	10.0	0.93 (0.89, 0.96)	
≥96	1,298	2.0	4,193	3.2	0.71 (0.67, 0.76)	

*Totals of subcategories may not equal the N of the entire cohort due to missing data ref, reference category

Table 2. Nursery length of stay for infants born to tobacco-using and non–tobacco-using women stratified by delivery type

Gestational age (weeks)	Vaginal delivery			Cesarean section delivery		
	Tobacco-using	Non–tobacco-using		Tobacco-using	Non–tobacco-using	
	Mean LOS in hours		*p*-value	Mean LOS in hours		*p*-value
35–36	52.3	52.9	0.19	75.4	80.4	<0.001
37–38	44.2	47.3	<0.001	69.8	75.4	<0.001
39–40	43.6	46.5	<0.001	70.2	76.0	<0.001
≥41	43.7	46.5	<0.001	71.0	75.7	<0.001
ALL	44.2	46.9	<0.001	70.5	76.0	<0.001

LOS, length of stay

non–tobacco users in the second column. The third column presents crude odds ratios, calculated with regard to the indicated reference category in cases where there are multiple categories. For example, compared with those aged 25 to 29 years, those aged <20 were 2.16 times more likely to be tobacco users than non-users. For the entire cohort, tobacco-using mothers were significantly younger, with a mean age at delivery of 25.8 years compared with 28.5 years for non-using mothers ($p<0.001$). The percentage born to teen mothers (aged <20 years) was higher for tobacco-using mothers (14.9%) compared with non-using mothers (7.9%; odds ratio (OR) 2.04; 95% confidence limit (CL) 1.99, 2.10). Tobacco-using mothers were more likely to be white (OR 1.41; 95% CL=1.37, 1.45) and less likely to be Hispanic (OR 0.65; 95% CL=0.62, 0.69).

Differences in marital status also existed, with 42.1% of tobacco-using mothers reported being married as compared with 75.6% of non-using mothers (OR 0.24; 95% CL=0.23, 0.24). Tobacco-using mothers were also significantly more likely to have no college education (OR 4.79; 95% CL=4.69, 4.90), and were more likely to have Medicaid (OR 4.29; 95% CL=4.20, 4.38) or be uninsured (OR 1.62; 95% CL=1.51, 1.73) as opposed to having private insurance. Tobacco-using mothers were significantly less likely than non-using mothers to have prenatal care beginning in the first trimester (OR 0.53; 95% CL=0.52, 0.54), but were significantly more likely to use alcohol and have pregnancy weight gain at both extremes of the spectrum compared to more normal patterns of weight gain.

Infant Characteristics

The mean birth weight for infants ≥35 weeks gestational age born to tobacco-using mothers was 3241 g. This was significantly lower than infants born to non-using mothers, whose mean weight was 3456 g ($p<0.001$). Similarly, infants of tobacco-using mothers were more likely to have low birth weight, defined as less than 2500 g (OR 2.49; 95% CL=2.37, 2.63), and they were more likely to be born between 35 and 36 weeks (OR 1.37; 95% CL=1.32, 1.44).

Mean nursery LOS was significantly shorter for infants born to tobacco-using mothers (48.9 hours vs 52.4 hours; $p<0.001$), and short nursery stays (<48 hours) were significantly more likely to occur for infants born to tobacco-using mothers (52.8% vs 44.2%; $p<0.001$). Newborns of tobacco users had shorter nursery stays after vaginal deliveries as well as Cesarean sections, with and without stratification for gestational age (Table 2).

Insurance Status and Length of Stay

To understand the effect of tobacco use on newborn LOS among different socioeconomic groups, insurance type was used as a proxy variable to determine the effect of SES on LOS for newborns of tobacco-using mothers. Newborns of tobacco users with higher SES (privately insured) and lower SES (uninsured or Medicaid insured) were both significantly more likely than similarly insured non–tobacco users to have an LOS <48 hours (low SES: 53.6% vs 47.3%, $p<0.001$; high SES: 51.7% vs 43.1%, $p<0.001$). An important note when comparing the SES categories is that newborns of lower-SES tobacco users were also significantly more likely than newborns of higher-SES tobacco users to have an LOS <48 hours (53.6% vs 51.7%; $p<0.001$).

Multivariable Analysis of Length of Stay

Tobacco-use differences in terms of LOS remained statistically significant in a multivariable model even after adjusting for numerous potential maternal and neonatal confounders associated with both mother's tobacco use and LOS. After adjusting for the covariates, the mean LOS for newborns of tobacco-using mothers was still significantly shorter than the mean LOS for newborns of non-using mothers by 3.1 hours (60.3 vs 63.4 hours; $p<0.001$). Maternal covariates significantly associated with a longer stay (all $p<0.05$) were health insurance (private longer than others); race (black longer than others); education (>4 years of college longer than others); not being married; primiparity; pregnancy-induced hypertension; chronic hyperten-

sion; and the timing of the initiation of prenatal care (no prenatal care longer than others). Delivery and infant covariates significantly associated with a longer stay (all $p<0.05$) were Cesarean section delivery, low birth weight, young gestational age at birth, and male gender. The only covariate not significantly associated with LOS but retained in the final model was maternal diabetes.

Cigarettes Smoked Per Day During Pregnancy and Newborn Length of Stay

Including only the cohort that self-reported tobacco use during pregnancy, newborn LOS was shown by unadjusted linear regression to be inversely related to the number of cigarettes smoked per day by mothers. For all deliveries, 10 additional cigarettes per day corresponded to an LOS approximately 1.2 hours shorter ($p<0.001$). This significant relationship existed for both vaginal and Cesarean deliveries (Figure 1).

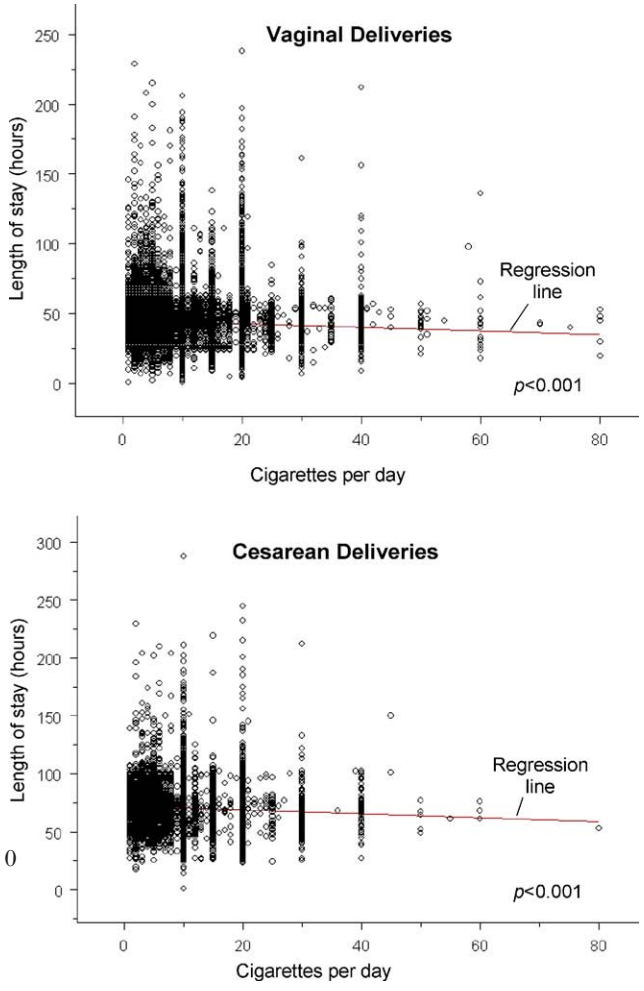

Figure 1. Relationship between maternal number of cigarettes smoked per day and length of stay for newborns following vaginal delivery and Cesarean section

Discussion

The results of this analysis demonstrate that infants born to mothers who reported smoking during pregnancy had a significantly shorter mean LOS in the hospital, even after adjusting for confounders related to both mother and newborn. Furthermore, there was a dose-response relationship between number of cigarettes smoked per day by mothers and decreasing nursery LOS for newborns. Additionally, the tobacco-using mothers were more likely to face socioeconomic disadvantage than non-using mothers. They were more likely to be insured by Medicaid, unmarried, adolescent, not college educated, and have late onset of prenatal care. Their newborns were more likely to be low birth weight and be born at 35–36 weeks gestation. Although a mean LOS difference of 3–4 hours may have only marginal clinical significance for an individual infant, our findings may well represent a meaningful population-level disparity. Even today, in the U.S., a substantial number of pregnant women smoke. As Geoffrey Rose illustrated,[16] a large number of people at seemingly small risk will usually give rise to more adverse events caused by this risk than a small number of people exposed to high risk. Additionally, as most hospital discharges occur in the morning, these data suggest that some tobacco-using women are leaving the hospital a day earlier than they might have otherwise. The data demonstrating the frequencies of short stays of <48 hours among tobacco users support this hypothesis.

The association between maternal tobacco use and shorter newborn nursery stays may represent an unintended consequence of hospital smoking ban policies, given the correlation between post-discharge newborn morbidity and shorter length of stay.[15,17–23] Shorter newborn stays may result in a failure to recognize conditions requiring intervention, such as jaundice, dehydration, ductal-dependent cardiac lesions, intestinal obstruction, seizures, and major infections.[17–22] Early discharge also has been associated with increased infant mortality, although this is controversial.[23] This problem is likely enhanced by the large socioeconomic and health disparities that exist between tobacco-using mothers and their infants and nonsmoking mothers and their infants. It may also be magnified further by entire hospital campuses having become entirely "smoke-free," as opposed to bans on smoking that apply only to indoor buildings. Today, in many hospitals, women can no longer easily walk outside of the hospital building to an area where smoking is permitted and then go back inside, as they could in the past.

The findings presented here are consistent with the one other study that included a similar analysis. Adams et al.[24] used the CDC's Pregnancy Risk Assessment Monitoring System database to analyze neonatal healthcare costs associated with maternal tobacco use in 13

states. Although not a major focus of their paper, the data presented also show a significantly shorter LOS for infants not admitted to the neonatal intensive care unit, a population similar to that in the current study.

Because hundreds of thousands of women each year are tobacco users and will plan hospitalization many months prior to giving birth, providers have ample time to counsel women about the risks of tobacco to the fetus and newborn and to initiate an evidence-based smoking cessation plan.[25] It should be recognized, however, that tobacco may serve a function, easing the stress associated with pregnancy and childbirth, and this barrier can be difficult to overcome.[26,27]

The numerous well-documented adverse effects associated with tobacco exposure to the developing fetus and young child include low birth weight, congenital defects, sudden infant death syndrome, behavioral problems, respiratory tract infections, asthma, and ear infections.[28] An additional reason to initiate smoking cessation during pregnancy is the known association between maternal smoking and the reduced likelihood of breastfeeding initiation and continuation.[29–32] Shorter maternity and nursery hospital stays can contribute to the reduced likelihood of breastfeeding.[33] Shorter stays may also contribute to the failure of the medical community to educate women who smoke about the relative risks and benefits of breastfeeding compared with formula feeding.[34]

This study is limited by several factors. First, it is a retrospective database analysis limited to a single state and only newborns admitted to well newborn nurseries. It does not therefore take into account regional variability in care or the increasing prevalence of "smoke-free" campuses that likely have occurred since 2002. This increased prevalence may cause the study findings to underestimate the current effect of maternal tobacco use on LOS. A second limitation is the likelihood that women under-report their use of tobacco during pregnancy,[35] and women self-reporting as non-users of tobacco may be misclassified for this analysis, potentially skewing the results in either direction. Third, nearly 20% of newborns did not have birth records that could be matched to and merged with a clinical discharge record. It is probable that urban mother–baby pairs are somewhat under-represented in our analytical sample because matching success was less likely in more highly populated ZIP codes. Finally, this study contains no information about the postnatal and postpartum care that the mother–baby pairs received, which has the potential to affect, positively or negatively, the health and well-being of new families.

In addition to the Joint Commission mandate,[1] several other factors have contributed to the evolution of smoke-free hospitals and campuses. These have included public image, concern for employee health, cost savings, fire safety, and employee pressure.[36] As a result, hospital smoking bans send a strong public health message regarding the risks of tobacco, and protect patients and staff from secondhand smoke (SHS) exposure. These data, however, demonstrate an unintended consequence for a vulnerable population: newborns of mothers who smoke. Because maternal cigarette smoking may lead to shorter newborn hospital stays, it should be considered in prenatal counseling and when hospital discharge is discussed.

Dr. Paul is supported by grant R40 MC 06630 from the Maternal Child Health Bureau (Title V, Social Security Act), Health Resources and Services Administration, USDHHS. A Penn State College of Medicine Dean's Feasibility Grant as well as a grant from the Children's Miracle Network awarded to Dr. Paul also supported this work. At the time of the research Dr. Widome was supported by center funding for the Healthy Youth Development Prevention Research Center, cooperative agreement 1 U48 DP000063-02 from the CDC. Co-author, Erik Lehman, MS, had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

The authors thank Edward Hain from the Pennsylvania Healthcare Cost Containment Council (PHC4) for his extensive technical assistance. Additional assistance was provided by Craig Edelman from the Pennsylvania Department of Health. PHC4, who provided the clinical discharge records, is an independent state agency responsible for addressing the problem of escalating health costs, ensuring the quality of health care, and increasing access to health care for all citizens regardless of ability to pay. PHC4 provided their data in an effort to further their mission of educating the public and containing healthcare costs in Pennsylvania. PHC4, its agents, and staff, have made no representation, guarantee, or warranty, express or implied, that the data—financial, patient, payer, and physician-specific information provided to this entity—are error-free, or that the use of the data will avoid differences of opinion or interpretation. The authors of this manuscript conducted this analysis without the assistance of PHC4, which bears no responsibility or liability for the results of the analysis. The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the U.S. government.

No other financial disclosures were reported by the authors of this paper.

References

1. U.S. Joint Commission on Accreditation of Healthcare Organizations. Accreditation manual for hospitals. Oakbrook Terrace IL: Joint Commission on Accreditation of Healthcare Organizations, 1992.
2. American Academy of Pediatrics Committee on Environmental Health. Environmental tobacco smoke: a hazard to children. Pediatrics 1997;99:639–42.
3. DeFrances CJ, Cullen KA, Kozak LJ. National Hospital Discharge Survey: 2005 annual summary with detailed diagnosis and procedure data. Vital Health Stat 2007;13:1–209.
4. Smoking during pregnancy—United States, 1990–2002. MMWR Morb Mortal Wkly Rep 2004;53:911–5.
5. Martin JA, Kung HC, Mathews TJ, et al. Annual summary of vital statistics: 2006. Pediatrics 2008;121:788–801.
6. Newborns' and Mothers' Health Protection Act of 1996. In: Pub L No 104-204, Section 601; 1996.

7. American Academy of Pediatrics: Committee on Fetus and Newborn. Hospital stay for healthy term newborns. Pediatrics 2004;113:1434–6.
8. Cardinal Health. MediQual. http://www.mediqual.com.
9. Grupp-Phelan J, Taylor JA, Liu LL, Davis RL. Early newborn hospital discharge and readmission for mild and severe jaundice. Arch Pediatr Adolesc Med 1999;153:1283–8.
10. Mandl KD, Brennan TA, Wise PH, Tronick EZ, Homer CJ. Maternal and infant health: effects of moderate reductions in postpartum length of stay. Arch Pediatr Adolesc Med 1997;151:915–21.
11. Mosen DM, Clark SL, Mundorff MB, Tracy DM, McKnight EC, Zollo MB. The medical and economic impact of the Newborns' and Mothers' Health Protection Act. Obstet Gynecol 2002;99:116–24.
12. Liu LL, Clemens CJ, Shay DK, Davis RL, Novack AH. The safety of newborn early discharge. The Washington State experience. JAMA 1997;278:293–8.
13. Edmonson MB, Stoddard JJ, Owens LM. Hospital readmission with feeding-related problems after early postpartum discharge of normal newborns. JAMA 1997;278:299–303.
14. Galbraith AA, Egerter SA, Marchi KS, Chavez G, Braveman PA. Newborn early discharge revisited: are California newborns receiving recommended postnatal services? Pediatrics 2003;111:364–71.
15. Paul IM, Lehman EB, Hollenbeak CS, Maisels MJ. Preventable newborn readmissions since passage of the Newborns' and Mothers' Health Protection Act. Pediatrics 2006;118:2349–58.
16. Rose G. Rose's strategy of preventive medicine: the complete original text. Oxford UK: Oxford University Press, 2008.
17. Hellman LM, Kohl SG, Palmer J. Early hospital discharge in obstetrics. Lancet 1962;1:227–32.
18. American Academy of Pediatrics: Committee on Fetus and Newborn. Hospital stay for healthy term newborns. Pediatrics 1995;96:788–90.
19. Maisels MJ, Kring E. Length of stay, jaundice, and hospital readmission. Pediatrics 1998;101:995–8.
20. Heimler R, Shekhawat P, Hoffman RG, Chetty VK, Sasidharan P. Hospital readmission and morbidity following early newborn discharge. Clin Pediatr 1998;37:609–15.
21. Graven MA, Cuddeback JK, Wyble L. Readmission for group B streptococci or Escherichia coli infection among full-term, singleton, vaginally delivered neonates after early discharge from Florida hospitals for births from 1992 through 1994. J Perinatol 1999;19:19–25.
22. Jackson GL, Kennedy KA, Sendelbach DM, et al. Problem identification in apparently well neonates: implications for early discharge. Clin Pediatr 2000;39:581–90.
23. Malkin JD, Garber S, Broder MS, Keeler E. Infant mortality and early postpartum discharge. Obstet Gynecol 2000;96:183–8.
24. Adams EK, Miller VP, Ernst C, Nishimura BK, Melvin C, Merritt R. Neonatal health care costs related to smoking during pregnancy. Health Econ 2002;11:193–206.
25. Fiore MC, Jaén CR, Baker TB, et al. Treating tobacco use and dependence: 2008 update. Clinical practice guideline. Rockville MD: USDHHS, Public Health Service, 2008.
26. Emmons KM, Cargill BR, Hecht J, Goldstein M, Milman R, Abrams DB. Characteristics of patients adhering to a hospital's no-smoking policy. Prev Med 1998;27:846–53.
27. Bullock LF, Mears JL, Woodcock C, Record R. Retrospective study of the association of stress and smoking during pregnancy in rural women. Addict Behav 2001;26:405–13.
28. DiFranza JR, Aligne CA, Weitzman M. Prenatal and postnatal environmental tobacco smoke exposure and children's health. Pediatrics 2004;113:1007–15.
29. Counsilman JJ, Mackay EV. Cigarette smoking by pregnant women with particular reference to their past and subsequent breast feeding behaviour. Aust N Z J Obstet Gynaecol 1985;25:101–7.
30. Ever-Hadani P, Seidman DS, Manor O, Harlap S. Breast feeding in Israel: maternal factors associated with choice and duration. J Epidemiol Community Health 1994;48:281–5.
31. Edwards N, Sims-Jones N, Breithaupt K. Smoking in pregnancy and postpartum: relationship to mothers' choices concerning infant nutrition. Can J Nurs Res 1998;30:83–98.
32. Leung GM, Lam TH, Ho LM. Breast-feeding and its relation to smoking and mode of delivery. Obstet Gynecol 2002;99:785–94.
33. Patel RR, Liebling RE, Murphy DJ. Effect of operative delivery in the second stage of labor on breastfeeding success. Birth 2003;30:255–60.
34. Bogen DL, Davies ED, Barnhart WC, Lucero CA, Moss DR. What do mothers think about concurrent breast-feeding and smoking? Ambul Pediatr 2008;8:200–4.
35. Walsh RA, Redman S, Adamson L. The accuracy of self-report of smoking status in pregnant women. Addict Behav 1996;21:675–9.
36. Longo DR, Feldman MM, Kruse RL, Brownson RC, Petroski GF, Hewett JE. Implementing smoking bans in American hospitals: results of a national survey. Tob Control 1998;7:47–55.